

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
Amendment of the Commission's Rules with)	GN Docket No. 12-354
Regard to Commercial Operations in the)	
3550-3650 MHz Band)	

To: the Commission

**COMMENTS OF
NATIONAL PUBLIC RADIO, INC.**

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Summary

Because public radio is completely dependent upon access to C-Band spectrum for the distribution of programming, avoiding interference from the proposed new Citizens Broadband Service ("CBS") is absolutely essential to avoiding disruption to public radio broadcast services on which millions of listeners rely each day. Despite NPR's repeated calls for more attention to this matter, however, it appears the Commission intends to move forward with authorizing CBS use without first developing the necessary protections to insulate C-Band use from CBS interference.

While the Commission has cited certain approaches to mitigating the CBS interference, those approaches do not amount to a solution to the problem. In particular, the use of band-pass filters offers only partial protection, and consideration of earth station "look angles" as part of the contemplated Spectrum Access System ("SAS") fails to account for environmental factors that may render such consideration less effective than the Commission assumes. Far greater assurance of protection is needed.

As a threshold matter, the Commission must disclose its technical assumptions regarding the CBS proposal. The lack of transparency is apparent from the admission that commenters to date have reached very different conclusions about CBS interference because they relied on very different assumptions about CBS devices, the capabilities of the SAS, receiver performance, and other technical criteria.

In addition, the Commission should create a greater spectral separation between CBS use and the C-Band spectrum and defer extending CBS use to the 3650-3700 MHz spectrum until it can point to a demonstrated lack of interference from CBS use of the 3550-3650 MHz band. Finally, just as it has done for the benefit of other adjacent spectrum users, the Commission should adopt a blanket requirement obligating CBS users to protect C-Band users from interference.

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Introduction

National Public Radio, Inc. ("NPR") hereby responds to the Further Notice of Proposed Rulemaking in the above-captioned proceeding seeking comment on rules to govern a new Citizens Broadband Service ("CBS") using spectrum in the 3550-3650 MHz ("3.5 GHz") band.¹

NPR is a non-profit membership corporation that produces and distributes noncommercial educational ("NCE") programming through more than 1000 public radio stations nationwide. In addition to broadcasting award winning NPR programming, including All Things Considered[®] and Morning Edition[®], NPR Member stations are themselves significant program producers and community institutions. NPR also operates the Public Radio Satellite System ("PRSS"), which enables a broad and diverse array of public radio program producers and radio stations to distribute programming for broadcast. Visionary pioneers at NPR established this first of its kind satellite-based interconnection system in the late 1970s.

¹ Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, Further Notice of Proposed Rulemaking, GN Docket No. 12-354 (rel. Apr. 23, 2014) [hereinafter "Further NPRM"].

Discussion

I. Interference To C-Band Spectrum Operations Could Disrupt The Broadcast Availability of Public Radio Programming Across The Country

NPR is troubled by the CBS operations proposed in the Further NPRM because of the failure to assure adequate protection for the distribution and broadcast of public radio programming throughout the United States. As NPR has explained in its prior comments in this proceeding,² most of the programming broadcast daily by public radio stations across the country, as well as the accompanying program-related data, is distributed via the PRSS. That distribution, in turn, depends on unimpaired access to the C-Band spectrum adjacent to the 3550-3650 MHz band proposed for CBS use.

The PRSS serves more than 400 downlinks across all 50 states. Figure 1, below, illustrates the PRSS earth station locations across the continental United States.³



² See Comments of National Public Radio, Inc., Public Notice, GN Docket No. 12-354, at 2 (filed, Dec. 5, 2013) [hereinafter "NPR Comments"].

³ These earth stations encompass a range of antenna elevation angles from more than 40 degrees in the southern states to less than 35 degrees in the northern states. In Alaska and

Today, all public radio listeners, numbering 36 million people on a weekly basis, depend on the C-Band spectrum for access to public radio programming.

Interference, even if it occurred intermittently rather than persistently, would block C-Band reception rather than merely producing artifacts in an otherwise usable signal. Such interference would therefore result in a catastrophic failure of a station's public radio service unless the station was prepared to use an alternative distribution source. Such redundancy is simply impractical on a system-wide basis, particularly given the constrained resources of most public radio stations and the public radio system as a whole. Without appropriate interference protection, these occurrences would therefore be both unpredictable and devastating. It is therefore absolutely essential for the Commission to insulate public radio C-Band users from harmful CBS interference before authorizing CBS operations to commence.

II. The Interference Mitigation Measures Suggested In The Further NPRM, Though Potentially Helpful, Are Far From Adequate

In addressing the potential harm to Fixed Satellite Service ("FSS") receivers in the C-Band, the Further NPRM points to several possible ways of mitigating CBS interference.⁴ These approaches may individually and collectively *contribute to* a solution, but they do not avoid the substantial risk of interference to C-Band earth stations. Known remedial measures, such as band-pass filters, are not a complete solution for several reasons, despite claims to the contrary.⁵

Hawaii, the elevation angles are below 10 degrees and 20 degrees, respectively. Downlink EIRP (effective isotropically radiated power) ranges from more than 42.6 dBW in the 48 states to 34.6 dBW in Hawaii.

⁴ See Further NPRM at ¶¶ 152-161.

⁵ The Further NPRM makes much of a claim that C-Band earth stations should not receive protection beyond the actual C-Band allocation based on the use of input signal processing devices capable of "listening" for transmissions as low as 3400 MHz. See id. at ¶ 158. The

In addition, a Spectrum Access System ("SAS") that dynamically assesses earth station "look angles" may help minimize interference, but factoring such "look angles" into the proposed SAS is not a simple matter, particularly in the case of C-Band earth stations located on college campuses (home to many public radio stations) and urban environments because of the presence of nearby buildings and other structures.

With respect to filters, the Further NPRM cites a claim that "many C-Band earth stations can effectively mitigate interference from commercial operations in the 3.5 GHz Band by utilizing readily available, low-cost filters."⁶ NPR's experience and empirical testing do not support such a claim. As shown in Figure 2, below, there are limits to the cut-off frequency of low noise block ("LNB") filters.

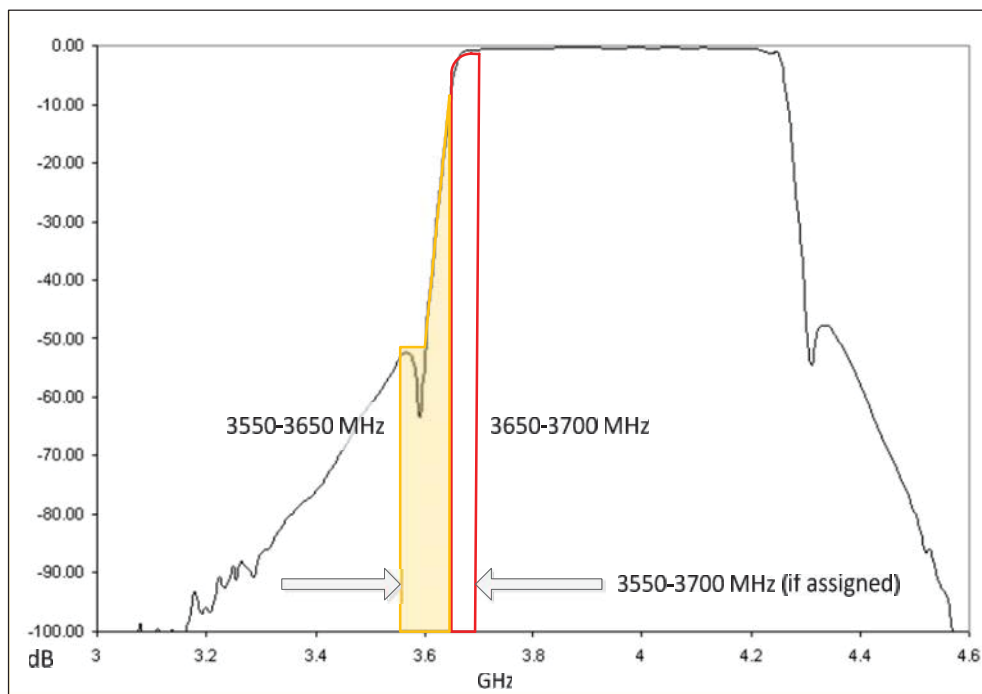


Figure 1 - Attenuation of Norsat BPF-C-1 filter relative to CBS frequency assignments

interference concerns expressed by NPR are not dependent on access to spectrum beyond the C-Band allocation for the United States.

⁶ Id. at ¶ 158.

Figure 2 shows the frequency attenuation characteristic of a commercial LNB filter from 3 GHz (3000 MHz) to 4.6 MHz. Attenuation is shown on the vertical scale from 0 dB (no loss) to 100 dB. Added to the chart, in orange, is the proposed assignment of wireless broadband CBS from 3550 to 3650 MHz. It is apparent that this filter's attenuation is only partially effective within this frequency band. Indeed, attenuation is only about 5 dB at the upper frequency assignment for CBS.

If the Commission decides to extend the CBS frequency allocation to 3700 MHz -- to create a "150 megahertz contiguous block of spectrum that could be used by existing licensees in the 3650-3700 MHz band -- as well as new licensees"⁷ -- an LNB filter may offer almost no attenuation to these additional frequencies, as shown boxed in red in Figure 2. Indeed, for CBS transmissions using the additional 50 MHz of spectrum, an LNB filter could admit interfering signals as if it were not in place.

Moreover, even when LNB filters are employed in earth station receivers, interference can occur from spurious emissions generated outside the CBS communications channel.⁸ Such interference occurs when the spurious emissions fall within the frequency range on which a satellite transponder is received by the C-Band earth station. LNB filters are ineffective in preventing this form of interference, which would require a combination of appropriate mask emission limits from CBS devices and geographic separation based on a conservative estimate of path-loss between the CBS devices and an earth station.

⁷ Id. at ¶ 163.

⁸ See id. at ¶ 159.

Finally, incorporating earth station "look angles" into the SAS database would also need to account for building "clutter" caused by adjacent structures, which can worsen potential interference. That is because the earth station's angular discrimination, as a function of the bearing of the interfering signal off the main beam of the earth station, can be substantially less than assumed for the same antenna in an open (uncluttered) environment.

As part of its tests of the interference susceptibility of PRSS earth stations, NPR Labs conducted tests of antenna discrimination in a full circle around several PRSS antenna installations. Rather than finding antenna discrimination that is representative of 3.7 meter prime focus dishes, NPR Labs found cases where significant loss of antenna directivity occurred as a result of reflection from buildings in the vicinity of the receive antenna.

Figure 3 is an image of the earth station used by WWNO-FM, New Orleans, LA, located on the campus of the University of New Orleans. The earth station receives just above an eight-story building, with an elevation angle of 53.7 degrees above the horizon. Other campus buildings are scattered around the antenna at varying distances and bearings.



Figure 2 - Earth station for WWNO, New Orleans, overlooking an 8-story building.

Tests with the survey horn, seen in the foreground of the photo at a height of 1.5 meters, determined that for a vertically polarized co-channel interfering signal on the PRSS transponder signal of 3805 MHz, the interference threshold was 8 dB worse from an angle of 180 degrees (directly behind the dish, as shown) than it was the same distance and directly below the main beam of the antenna. However, at 90 degrees off the main beam the interference threshold was 13 dB better than it was behind the antenna. While it is certain that the antenna directivity was normal, the poor discrimination behind the antenna was caused by re-radiation from buildings and other structures around the antenna.

NPR Labs conducted similar testing, with similar results, in the immediate vicinity of the PRSS earth station located on the campus of Pacific Lutheran University, licensee of KPLU-FM, Tacoma, Washington. As Figure 4 shows, the antenna is mounted higher on a pedestal than the WWNO earth station antenna, but its elevation angle is only 31.2 degrees.



Figure 3 - Signal testing of the earth station for KPLU, Tacoma

This site is again surrounded by campus buildings in various directions. One building, seen beyond the dish, is only two stories in height, with metal flashings around its roof. Tests with horizontal polarization for a co-channel interfering signal found attenuations of only 11, 5 and 7 dB at orientations of 60, 90 and 180 degrees relative to the signal received below the main beam on 3805 MHz. At 3760 MHz, the attenuations were only 11, 3 and 3 dB relative to the main beam threshold. With a vertically polarized interfering signal, the interference on 3760 MHz was attenuated by on 6 and 2 dB for 90 and 180 degrees, respectively.

These field tests illustrate that, because of re-radiation building clutter, simply incorporating earth station "look angles" into the SAS will not produce the results that would be expected if the earth station were in a completely open environment. Moreover, the contemplated SAS would have to capture significantly more data to account for buildings and other structures in the immediate vicinity of a C-Band earth station.⁹ Thus, we urge the Commission to avoid an over-reliance on earth station "look angles" or earth station filters when developing exclusion zones for C-Band earth stations.

III. Additional Modifications To The CBS Proposal Are Essential

The Further NPRM concedes that "the proposed Part 96 rules do not necessarily address all concerns about potential interference into C-Band earth stations raised in the record."¹⁰ It also invites "comment on additional mitigation strategies that could be employed to prevent harmful interference."¹¹ NPR therefore offers several mitigation strategies below. None would

⁹ Even without such additional complexity, the contemplated system would be "conceptually similar to, but more advanced than the databases used to manage Television White Spaces (TVWS) devices." Id. at ¶ 6.

¹⁰ Id. at ¶ 159.

¹¹ Id. at ¶ 159.

adversely affect the future success of the CBS initiative, but they do require the Commission to revisit certain of its tentative conclusions.

A. The Commission Should Make More Of Its Technical Assumptions Explicit

As a threshold matter, the difficulty in determining the precise harms or mitigation strategies associated with the CBS proposal stems from an absence of more specific technical information about the proposal. NPR has commented on this failing in its prior comments.¹² While the Further NPRM is somewhat more forthcoming, explicit detail in important respects is still lacking.

The lack of sufficient technical information is apparent from the discussion of the C-Band interference issue in the Further NPRM, in which it is clear that parties have had to make significant assumptions about the CBS technical requirements.

We also sought comment on methods for mitigating potential harmful interference from Citizens Broadband Radio Service operations into these [C-Band] receivers. Parties submitted multiple comments, presentations, and technical analyses related to this issue. These submissions relied on very different assumptions about CBSDs, the capabilities of the SAS, receiver performance, and other technical criteria and, as a result, commenters reached very different conclusions regarding the need for protection for C-Band earth stations.¹³

In other contexts, the Commission has extolled the virtue of transparency,¹⁴ a virtue NPR heartedly endorses, and we urge the Commission to provide additional information about the Commission's technical assumptions about CBSDs, the capabilities of the SAS, receiver performance, and other technical criteria.

¹² See NPR Comments at 2-3.

¹³ Further NPRM at ¶ 152 (emphasis added).

¹⁴ See In the Matter of Protecting and Promoting the Open Internet, Notice of Proposed Rulemaking, GN Docket No. 14-28, at ¶ 63 (rel. May 15, 2014).

B. Because Consumer End User Equipment Associated With General Authorized Access ("GAA") Use Cannot Be Kept Geographically Separate From C-Band Earth Station Operations, The Commission Should Allocate The 3550-3650 So GAA Users Are Spectrally Separate Away From The C-Band Spectrum

The Further NPRM proposes to authorize General Authorized Access ("GAA") use and Priority Access Licenses ("PALs") throughout the relevant band rather than assigning each to fixed spectral locations "(e.g., GAA from 3550-3600 MHz and Priority Access from 3600-3650)." ¹⁵ This proposal is at odds with the Commission's expressed interest in avoiding interference to C-Band users and assumptions about such interference stated elsewhere in the Further NPRM. Because the proposal is also not necessary to assure the successful implementation of the CBS initiative, NPR urges the Commission to consider alternative approaches.

As envisioned, the PALs would only be available to entities eligible to hold an FCC license and a PAL would impose regulatory obligations, including to avoid interference to specified incumbent users, and therefore accountability to address specific problems as they arise. ¹⁶ GAA use, by contrast, would be on an unlicensed basis, with interference avoidance assumed by the required use of certified, Commission-approved CBS devices and registration with the SAS. ¹⁷ While the source of and responsibility for interference to a C-Band earth station could be identified if the interference were caused by a PAL operation, the same is not true for GAA use. In the case of interference caused by GAA use, it is unclear what remedial measures the Commission could readily adopt.

¹⁵ Further NPRM at ¶ 28.

¹⁶ Id. at ¶ 42.

¹⁷ Id. at ¶ 56.

Allowing PAL and GAA use throughout the 3.5 GHz band is also inconsistent with the Commission's apparent assumptions about the likely causes of CBS interference to C-Band earth stations. In particular, the Further NPRM appears to assume that "any potential interference would come from operations in close spatial and spectral proximity to [C-Band] earth stations."¹⁸ and that such interference can be mitigated in part by "the appropriate placement of Citizens Broadband devices"¹⁹ Since GAA use will be authorized on an unlicensed basis, there would be no obvious means to assure "the appropriate placement of Citizens Broadband devices" or the avoidance of such operations in "close spatial proximity to" C-Band earth stations. The only prudent course would therefore be to limit the spectral proximity of such GAA operations and consumer devices in relation to the C-Band spectrum.

Modestly restricting the spectrum accessible to GAA devices can also be accomplished without unduly restricting the amount spectrum available for such use. While the Commission proposes not to bifurcate the 100 MHz of spectrum it intends to make available for CBS use,²⁰ that is not the only way to assign GAA users and PAL licensees to fixed spectral locations. Another approach would be to allow PAL use throughout the CBS spectrum, while restricting GAA use to most but not all of the CBS spectrum, excluding GAA use in the spectrum closest to the C-Band Spectrum. For instance, GAA use might occur from 3550-3620 MHz and PAL use from 3550-3650 MHz. Allowing 70 MHz of spectrum for GAA use compares favorably to the minimum amounts proposed in the Further NPRM and advocated by GAA use proponents.²¹

¹⁸ See id. at ¶ 156 (emphasis added).

¹⁹ See id. at ¶ 157 (emphasis added).

²⁰ See id. at ¶ 28

²¹ See id. at ¶¶ 28 and 30.

Because this alternative approach would afford C-Band operations additional interference protection while advancing the Commission's interest in robust GAA use, we urge its adoption.

C. The Commission Should Defer Transitioning the 3650-3700 MHz Band To CBS Use Until CBS Use of the 3550-3650 MHz Band On A Non-Interfering Basis Has Been Established

The Further NPRM proposes to include the 3550-3650 MHz in the new Part 96 rules governing CBS use, while also expressing the Commission's interest in extending CBS use to include the 3650-3700 MHz band sometime in the future.²² In discussing potential interference attributable to out-of-band emissions, moreover, the Further NPRM acknowledges that a "spectral transition gap," or guardband, "immediately above and below the edges of the 3.5 GHz Band may be necessary given the limitations of RF/radio filter technology."²³ At the same time, however, the Further NPRM goes on to propose rules to begin incorporating the additional 50 MHz of spectrum into the band allocated for CBS use.²⁴ The transitional rules appear only to accommodate incumbent users of the additional spectrum and not the immediately adjacent C-Band earth stations, and there is no discussion of a guardband to protect C-Band operations.

Given the uncertainty concerning the potential interference that may be caused by CBS operations to C-Band earth stations, the Commission should defer extending the spectrum authorized for CBS use until after such use has been established and demonstrated to operate without causing harmful interference to adjacent spectrum operations.

²² See id. at ¶¶ 163-169.

²³ Id. at ¶ 84.

²⁴ Id. at ¶¶ 166-67.

D. The Part 96 Rules Should Include An Express Obligation To Protect Incumbent C-Band Operations From Interference

The Further NPRM proposes an obligation to protect federal users in the 3.5 GHz Band, existing earth stations in the 3.5 GHz Band, and users along the Canadian and Mexican Borders according to international agreements with those countries. Since, as noted above,²⁵ the Further NPRM concedes that the proposed CBS rules do not necessarily afford sufficient protection to C-Band earth stations and invites comment on additional mitigation strategies, it is unclear why the Commission would impose an obligation to protect other potentially affected incumbent spectrum users but not C-Band spectrum users. After all, the nature and extent of CBS interference to all these existing services is similarly uncertain. The Commission should therefore adopt a blanket protection obligation for the benefit of C-Band earth stations.

²⁵ See note ¹⁰, infra, and accompanying text.

Conclusion

For the foregoing reasons, and as demonstrated more fully above, NPR urges the Commission to implement more rigorous safeguards to protect public radio services from potentially significant interference from the proposed Citizens Broadband Radio Service.

Respectfully submitted,

NATIONAL PUBLIC RADIO, INC.

A handwritten signature in dark ink, appearing to read "Jonathan D. Hart", is positioned above the typed name.

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